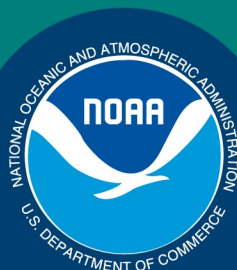


Science, Service, Stewardship



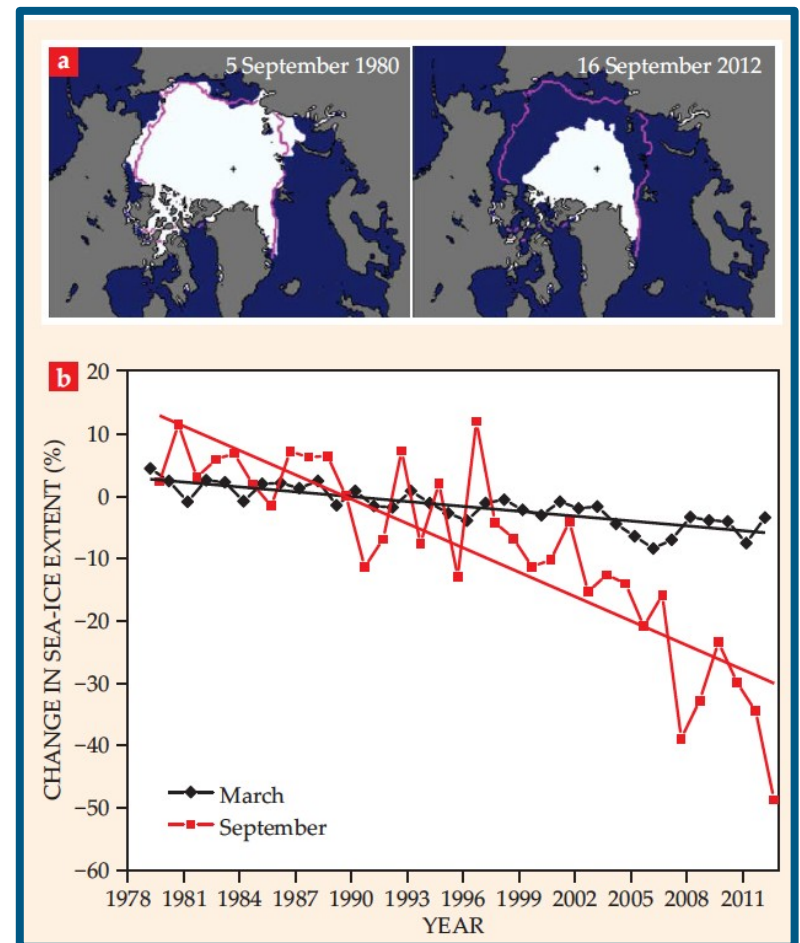
Climate change-related research: Investigating population structure in gray whales and ice seals

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Understanding population structure in a changing environment

- Many marine mammals depend on the Arctic marine ecosystem
- The Arctic marine ecosystem is rapidly changing, including:
 - Dramatic loss of sea ice
 - Rising sea temperatures
 - Ocean acidification
- These changes will not affect all areas in the same way
- Understanding the population structure is critical to evaluate potential impacts of these changes



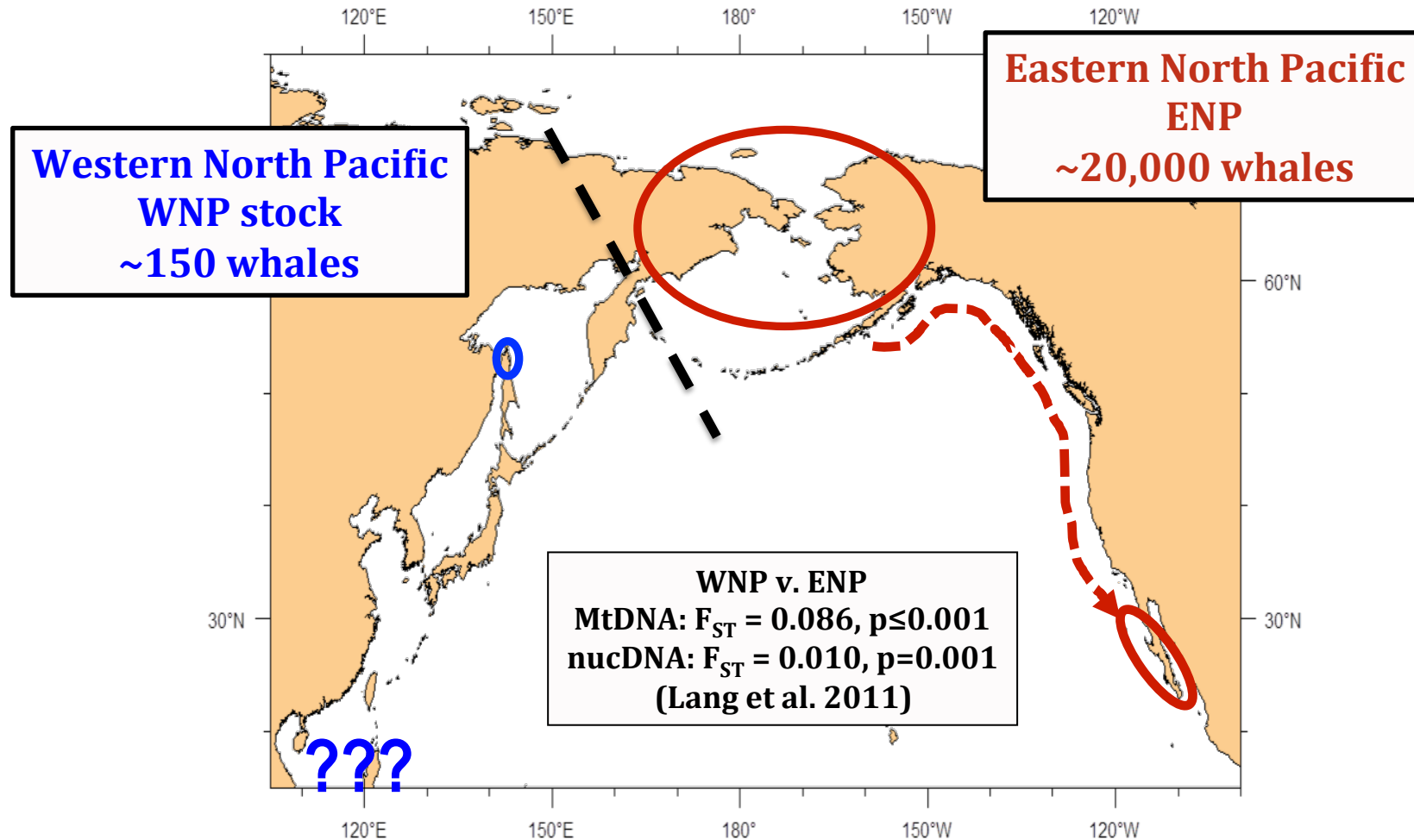
Jeffries et al. 2013

Case Study #1: Gray whales – a ‘sentinel species’ for monitoring Arctic environmental changes?

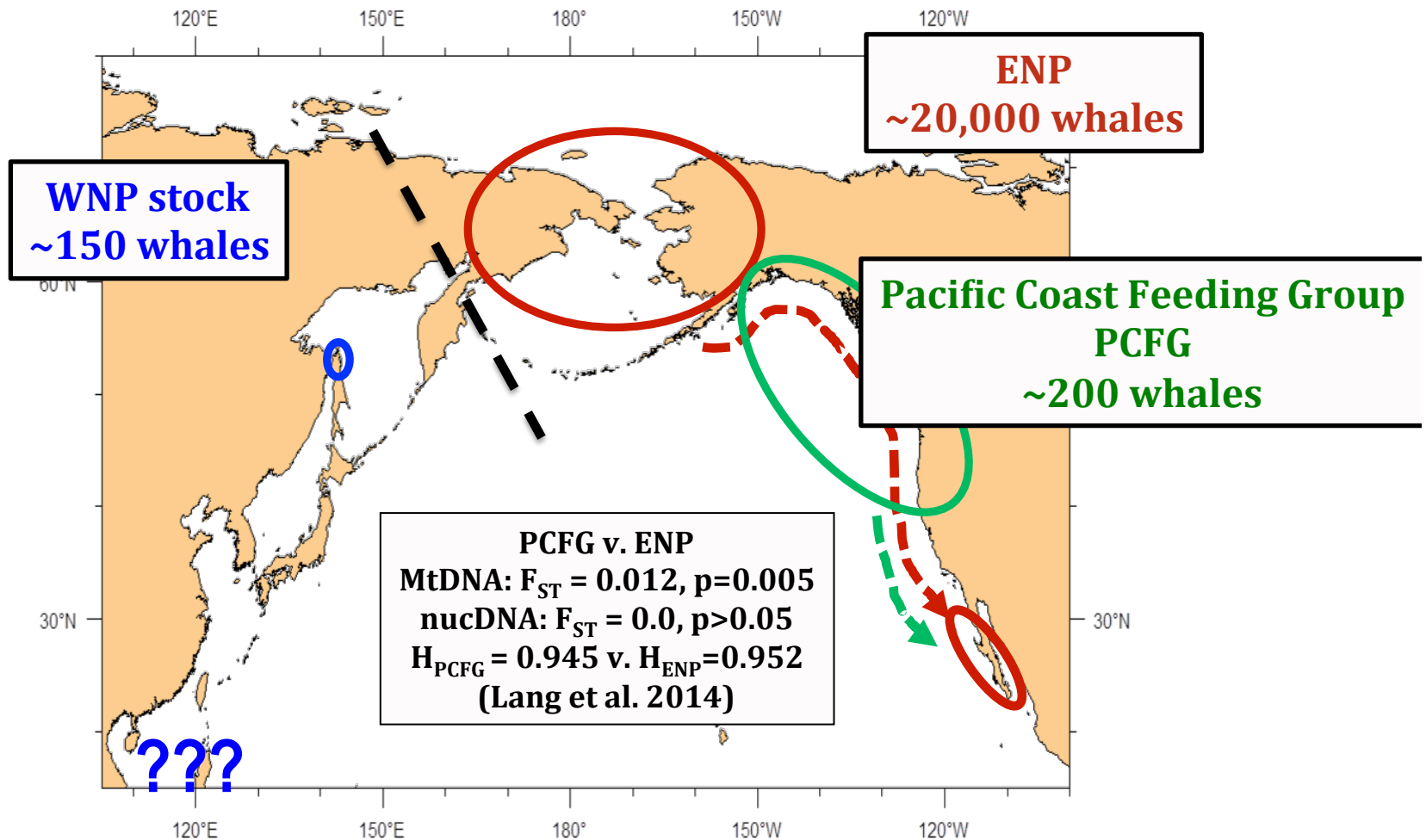
- Calving rates positively correlated with early-season ice-free conditions
- Shift in distribution on Bering Sea feeding grounds and in timing of southbound migration
- Recordings of gray whales in the Arctic during winter months
- Movements of gray whales into the Atlantic



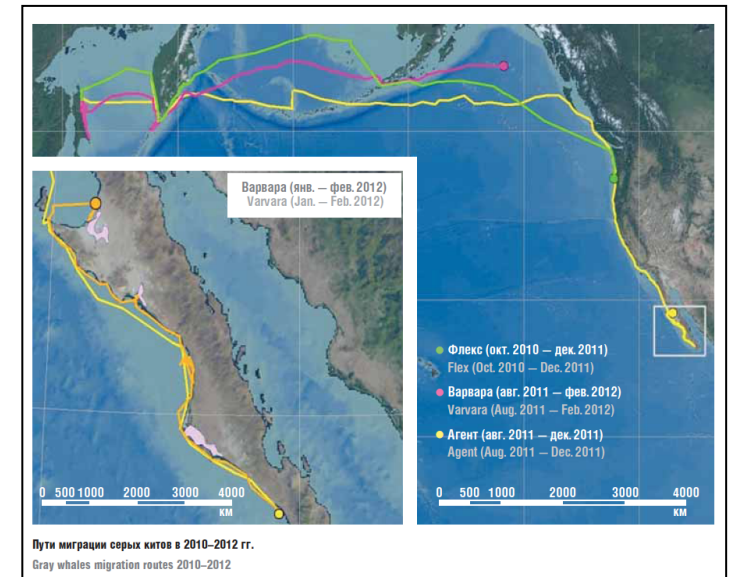
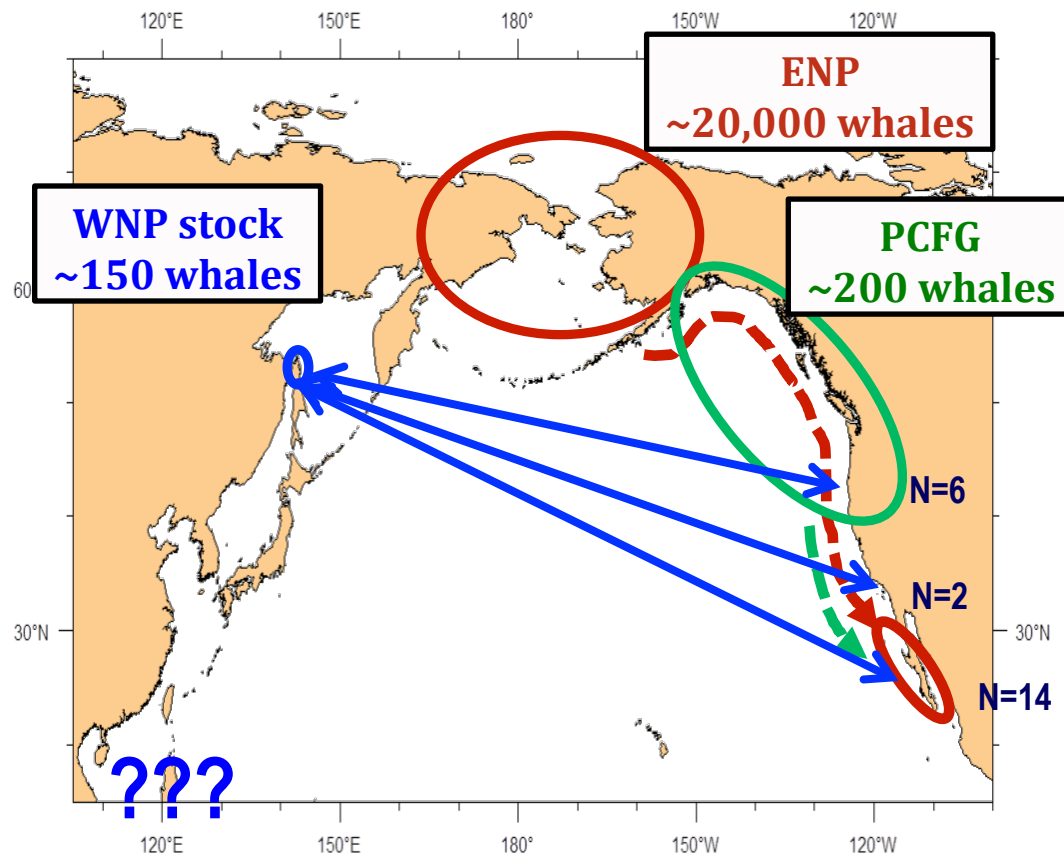
Stock structure of gray whales in the North Pacific: An evolving picture



Stock structure of gray whales in the North Pacific: An evolving picture



Recent findings from genetics, photo-identification, and tagging studies show that some gray whales that feed off Sakhalin overwinter in the ENP (Lang 2010, Mate et al. 2011, Weller et al. 2012, Urban et al. 2012).



However, a small number of records (n=23) of gray whales off Japan and China exist; the majority of records are between March and May, when gray whales would be expected to be migrating north.

How many stocks of gray whales exist?

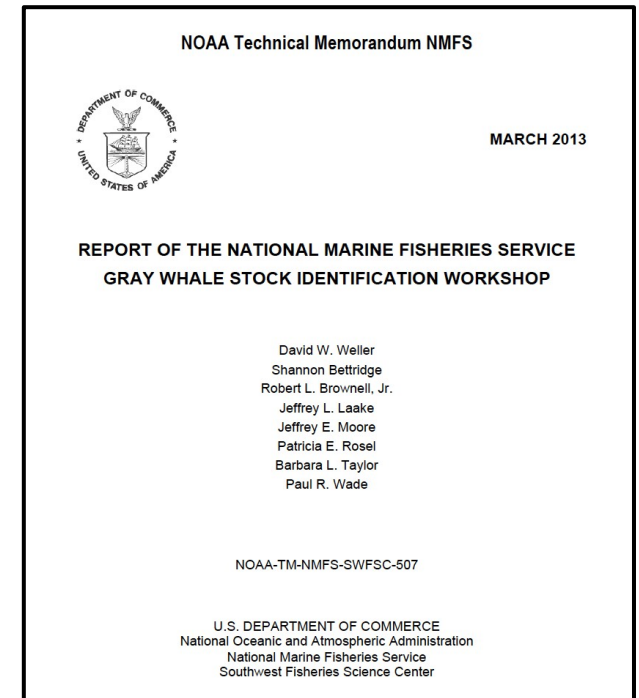
Ask the experts!

- In 2012, NMFS established a scientific Task Force (TF) to evaluate gray whale stock structure
- The primary objective was to answer two questions:

1) *“Is the WNP a ‘population stock’ under the agency’s interpretation of the MMPA”?*

The TF provided unambiguous advice that the WNP stock should be recognized as a population stock

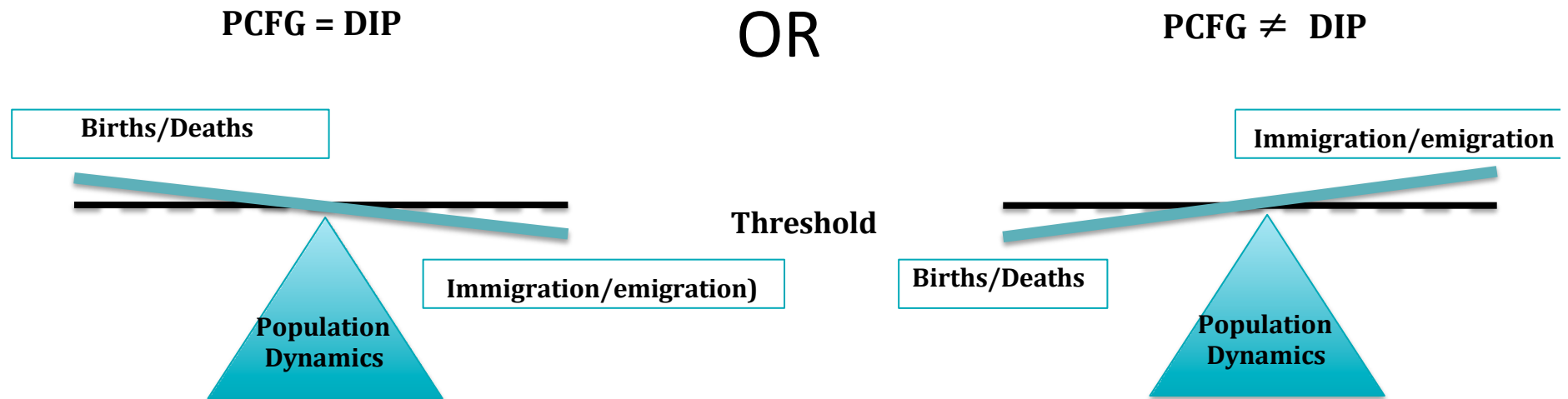
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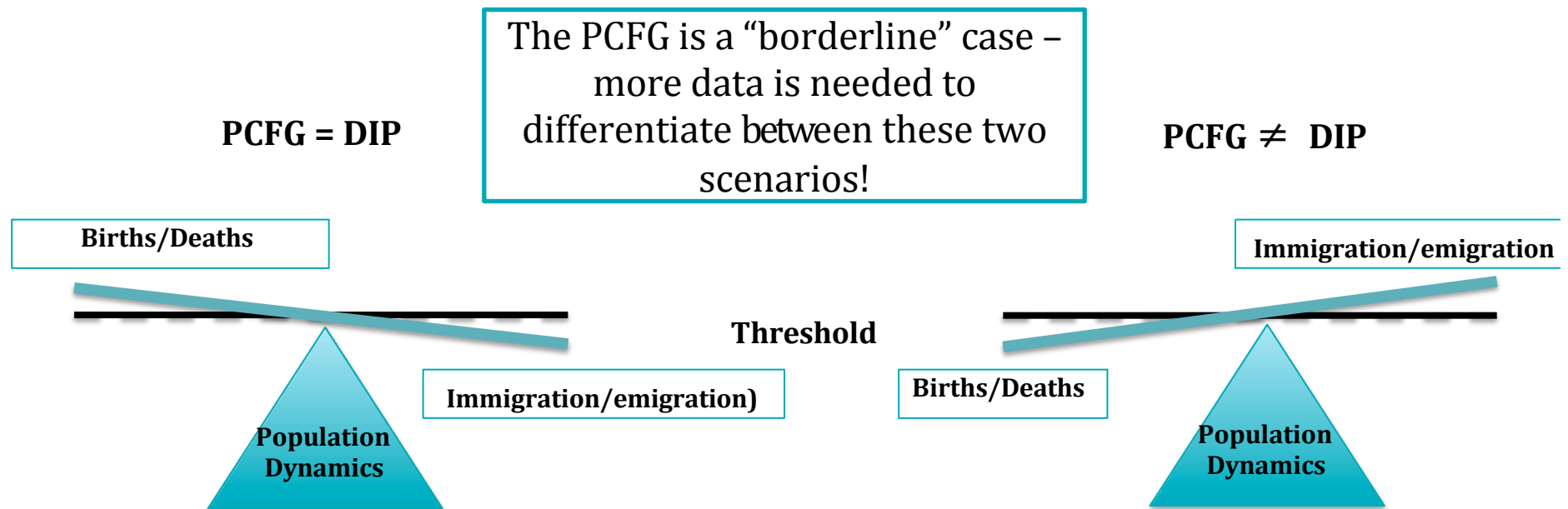
2) “Is the PCFG a ‘population stock’ under the agency’s interpretation of the MMPA”?

- Lots of data already:
 - >15 years of photo-id studies
 - 70+ biopsy samples
 - 35 whales tagged
- Genetic simulations indicate that the level of external recruitment (immigration) is close to the threshold for designating a DIP
- The TF was unable to provide definitive advice as to whether the PCFG is a population stock



2) “Is the PCFG a ‘population stock’ under the agency's interpretation of the MMPA”?

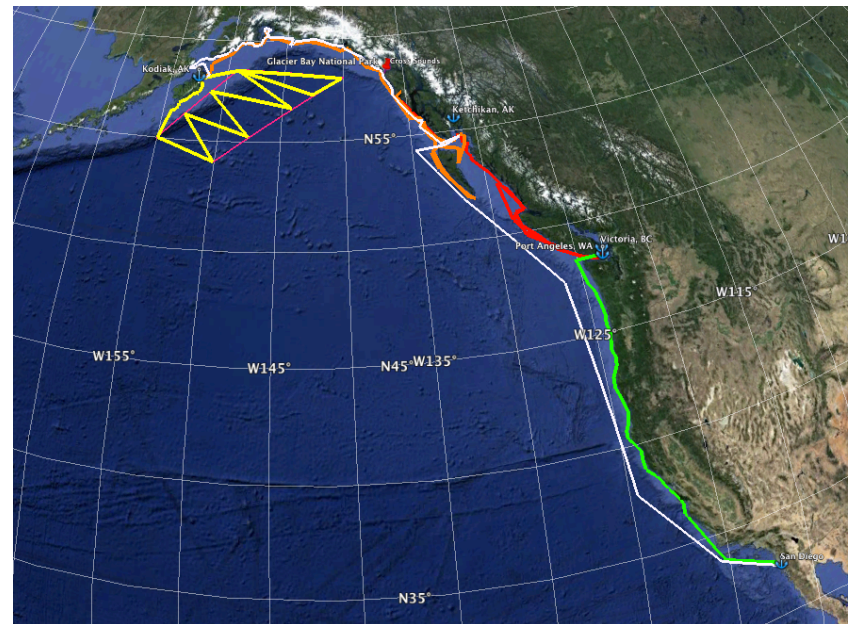
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What's next?

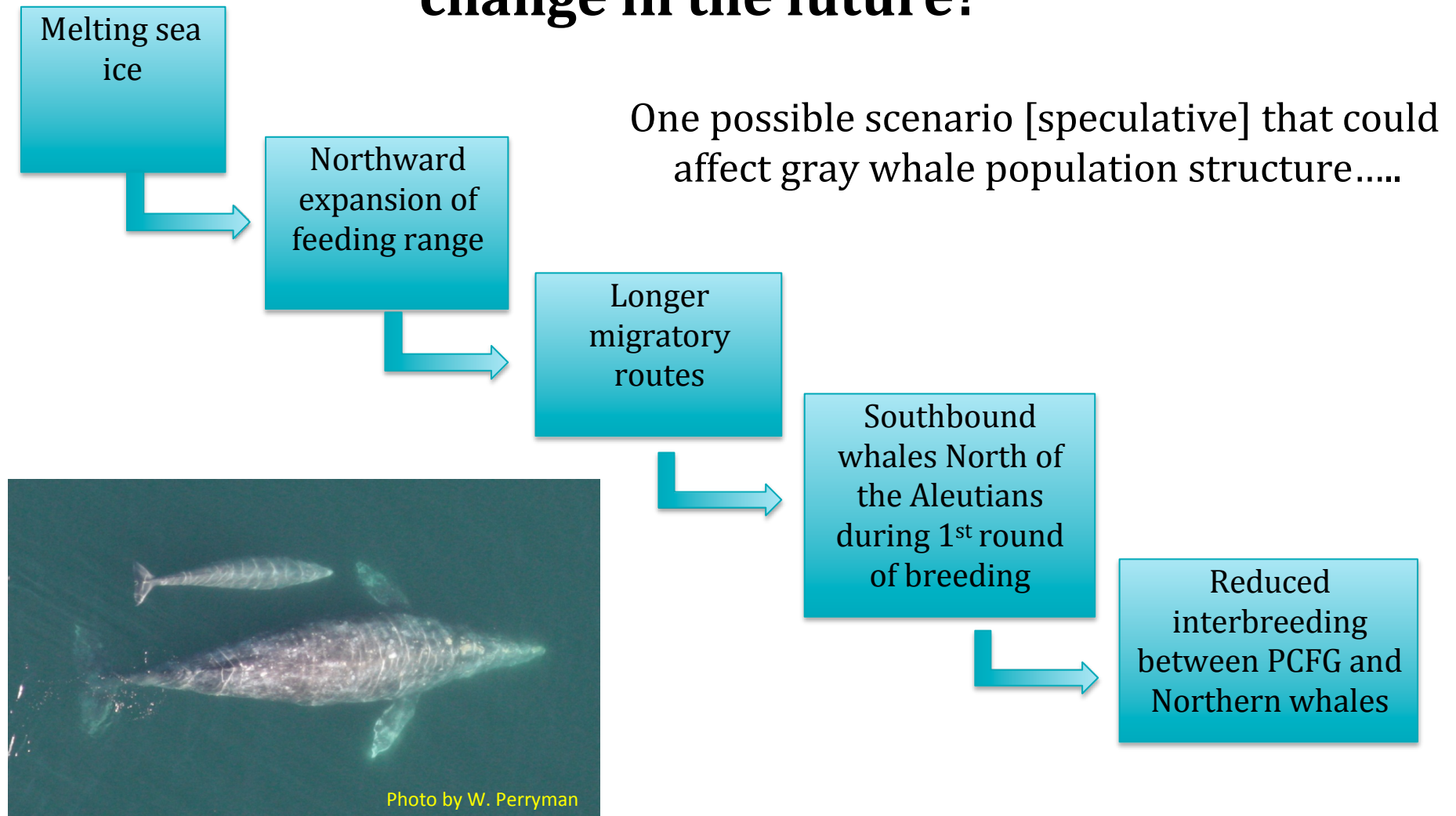
- A large whale survey (CLAWS) is currently being conducted between northern CA and Kodiak Island, AK
- A primary goal of CLAWS is to fill in some data gaps for the PCFG:
 - Collect data from areas with little past survey effort
 - Collect additional photo-id data and genetic samples to further assess recruitment into the PCFG (e.g., are “new” whales immigrants or whales missed as calves?)

Collaborative Large Whale Survey:
9 July – 9 November, 2015
Dave Weller, Chief Scientist



CLAWS 2015 tracklines, color-coded by leg

Could the population structure of gray whales change in the future?



Case Study #2: Arctic ice seals

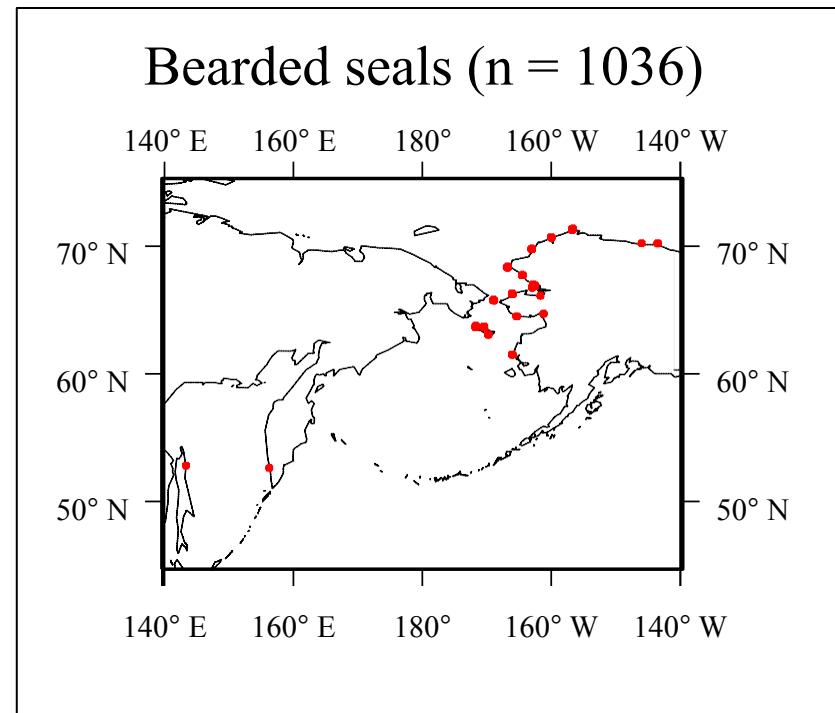
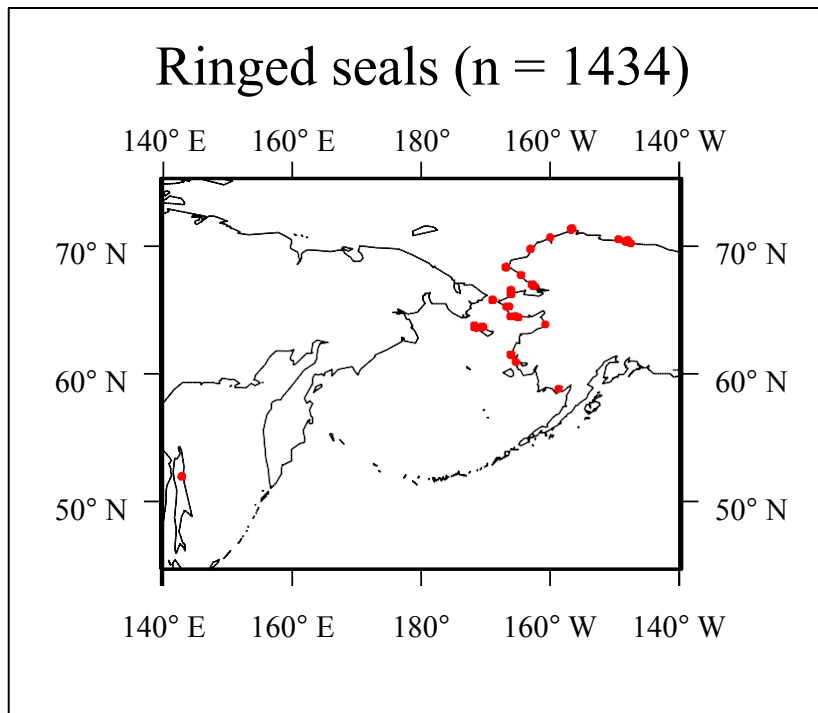
- Bearded and ringed seals are “ice obligate” species
- For both, only a single stock is recognized in U.S. waters
- Recent status reviews for both species noted that:
 - Changes in sea ice and snow cover are likely to lead to future population declines
 - A better understanding of population structure is needed to evaluate potential impacts of climate change



To

Samples archived in the SWFSC Tissue Collection

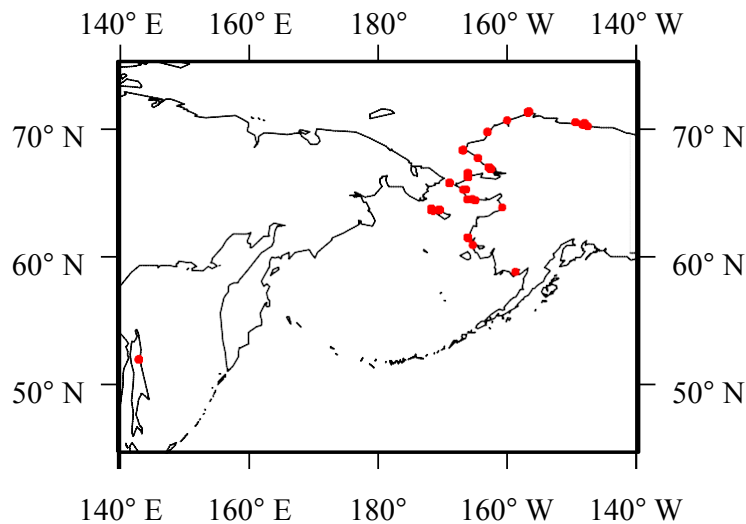
- Collected between mid-1990s and present
- Most from harvested seals



Samples archived in the SWFSC Tissue Collection

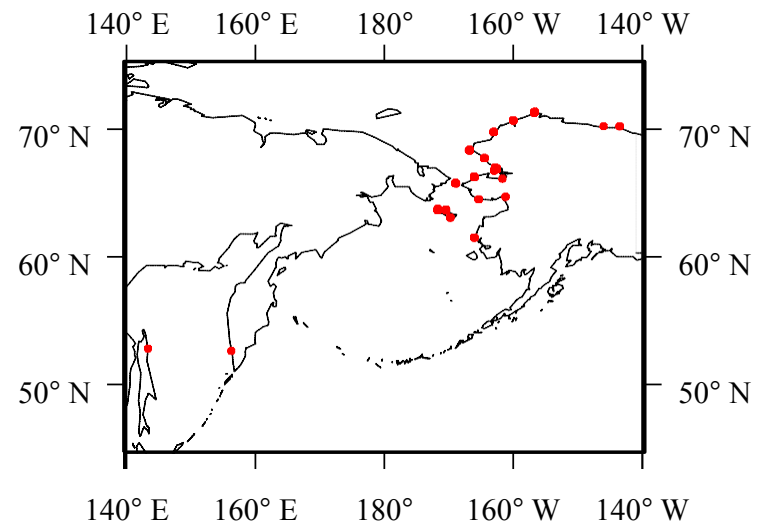
- Collected between mid-1990s and present
- Most from harvested seals

Ringed seals (n = 1434)



mtDNA sequence & genetic sexing (n=381)

Bearded seals (n = 1036)



mtDNA sequence & genetic sexing (n=448)
SNP discovery